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MORPHOLOGY OF THE IMMATURE STAGES OF *EVERES COMYNTAS* GODART (LYCAENIDAE)

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KNOWLEDGE OF THE EXTERNAL MORPHOLOGY of the immature stages of butterflies is quite incomplete. Most of the past work has dealt with moths, and on groups which many researchers consider the more "generalized" immature Lepidoptera. The more "specialized" groups, including the Lycaenidae, have been neglected. It is hoped that this detailed study of one species will provide a morphological platform on which to launch more intensive comparative studies within the family. To that end we have arranged the description of the larval morphology by individual structures rather than the more conventional treatment of describing each instar. This makes more emphatic the ontogenic changes in addition to any individual variations. The latter must be recognized before the former become meaningful.

Everes comyntas Godart is common throughout the Nearctic region and its range extends southward as far as Costa Rica. Eggs and larvae are found on white clover (*Trifolium repans* L.), red clover (*T. pratensis* L.) and lespedeza (*Lespedeza stipulaceae* Maxim.). Pupae have also been found on lespedeza and curly dock (*Rumex crispus* L.). Details of the population dynamics of this species will be published elsewhere.

PREVIOUS DESCRIPTIONS OF THE IMMATURE STAGES

Edwards (1876) gives an account of the early stages of *Everes comyntas* and gives measurements of the egg, larval stages and pupa. No illustrations were included. Scudder (1889) describes and gives three illustrations of the egg, including two views of the micropyle (*loc. cit.*, Vol. 3, Pl. 68, figs. 5 and 12) and an oblique view of the entire egg (*loc. cit.*, Vol. 3, Pl. 65, fig. 20). The latter appears to us to have too few reticulations in the surface. The same author has illustrated a dorsal view of the first instar larva, several head capsules, and pupae, all of which are accurate but, partly due to small size, lack specific details. Dethier (1941) pictures the larval antenna of *comyntas* in his

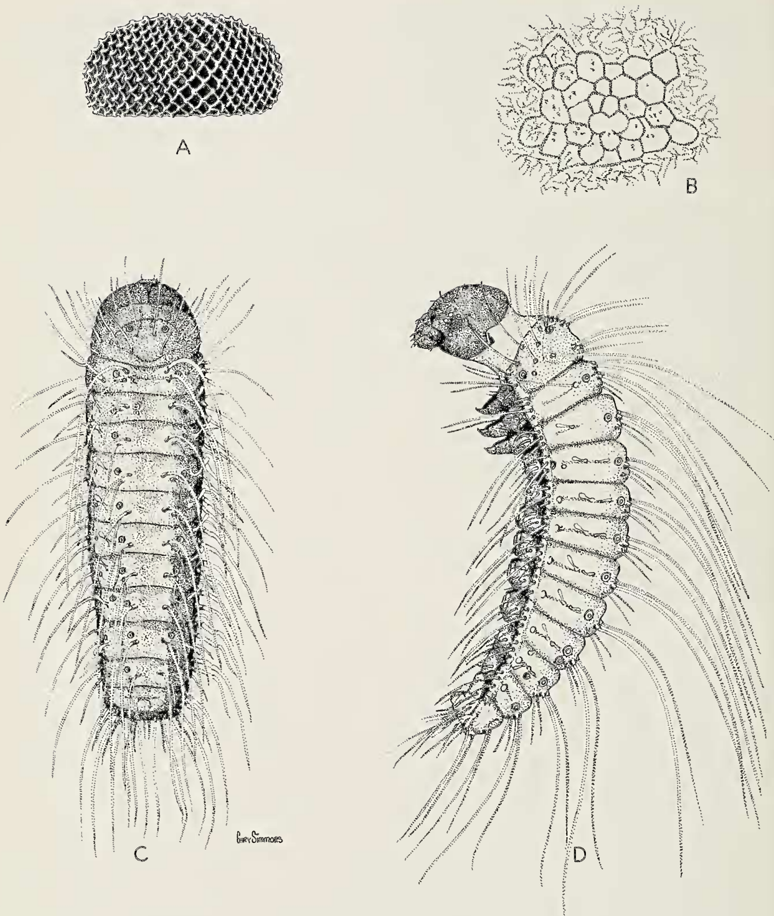

Fig. 1. Immature Stages of *Everes comyntas* Godart.
A—B. Egg; A. Lateral view. B. Dorsal view of micropylar area. C—D. First instar larva; C. Dorsal view. D. Lateral view.

comprehensive paper on the antennae of Lepidoptera. The immature stages are superficially described or illustrated in several other more general works, but these are overly simplified and are usually not diagnostic either of the species, or in some cases, the family.

THE EGG

Figure 1B is a lateral view of the egg which shows its typical lycaenid form. It is of turban shape, flat on the bottom and less noticeably truncate on top. The sides and top are covered with reticulations which are slightly elevated from the surface. Rounded prominences are found at the intersections of this network of ridges, giving the egg the appearance of an echinoid test. The diameter is 0.6 mm; the height, 0.3 mm.

The micropylar area (Fig. 1B) is only slightly depressed into the central vertical axis of the upper surface. Its central cavity consists of either three or four petal-shaped cells, open at their bases. These central cells are surrounded by other cells whose walls are of similar structure except that each cell has a complete wall. They vary from semi-round to hexagonal in shape. From one to three of these cells may occur between the petal-cells and the transition zone (see below). The walls of all cells in the micropylar area are uniform in thickness and appear to have a slight greenish tint under high magnification. Various unknown inclusions showing this same tint occur in most of the peripheral cells of the area. This region of the egg is of the same general type as other Nearctic Plebejini but is diagnostic of this species.

There is a small transition zone between the area of the micropyle and the elevated reticulations which characterize the dorso-lateral margins and sides of the egg. Although the lateral limits of this zone are often difficult to judge, the region is dissimilar to the other areas in that there is no regularity or uniformity to the walls of the opaque cells involved.

Radiating out from the transition zone is a network of raised, solid ridges arranged in tolerably regular oblique rows running across the top and down the sides of the egg. These are connected by another series of slender ridges which also run in an oblique direction, but at right angles to the first ridges.

As indicated above, there is a slight prominence or knobby elevation at the intersection of each ridge. The knobs are largest and most obvious on the sides and obsolescent near the transition zone and on the ventral surface. The ridges appear to be continuous with the walls of the cells in the transition zone, but they are marked by their elevation, prominence, knobbed intersections and regularity. The surface of the egg opposite the micropyle contains hexagonal cells, defined by their walls, which are uniform in thickness and, except for their regular shape, resemble the cells in the transition zone on the dorsal surface. The areas between the walls are transparent in hatched eggs, though the entire area may be obscured by the substrate of maternal origin used to attach the egg to a surface.

In the living egg the thickened ridges appear white in color while the depressed areas between them are light green, reflecting the embryonic contents. A slight darkening of the punctuations occurs before hatching, or if the egg is parasitized. The general appearance of the egg, size, reticulations and micropylar area are distinguishing features which help separate this species from allied forms.

THE LARVA

CRANIUM: The terminology of the sclerites and sutures of the cranium, especially as concerns the lepidopterous larva, has undergone much revision in the past two decades. Short (1951) reviews the various studies concerned with determining the nature of the sclerites and sutures of the cranium. One can only conclude from this review that no set of terms has as yet been worked out which would be satisfoctory to all entomologists. The system of Hinton (1947) has been used herein with slight modifications when referring to specific sclerites or sutures.

The cranium of *E. comyntas* lacks conspicuous lateral cleavage lines (frontal sutures of Hinton or adfrontal sutures of many authors), see Fig. 2A. Other lycaenids including *Plebejus icarioides* (Bdv.) and *Plebejus melissa* (Edw.) also lack these frontal sutures. Most moth larvae have the sutures, although as Ripley (1923) points out, they may not appear except in the mature larvae. These lines are not mentioned by Clark and Dickson (1956) in any of their detailed studies on numerous species of South African lycaenids.

Measuring the head capsule width is a reliable method for determining the four larval stages of this species. There is no overlap of head capsule width between instars. The ranges of head capsule width are as follows (measured between widest points):

First Instar	.186–.207 mm.
Second Instar	.285–.313 mm.
Third Instar	.492–.519 mm.
Fourth Instar	.855–.923 mm.

In addition, a nearly constant 1 to 1 ratio was obtained in all instars by dividing the width of the fronto-clypeal apotome (taken as the distance between seta C1 on the right side and C1 on the left) by its length (taken as the distance between the anteclypeus (ac) and apex of the triangle formed by the lateral adfrontal sutures (adl) (See Fig. 2A).

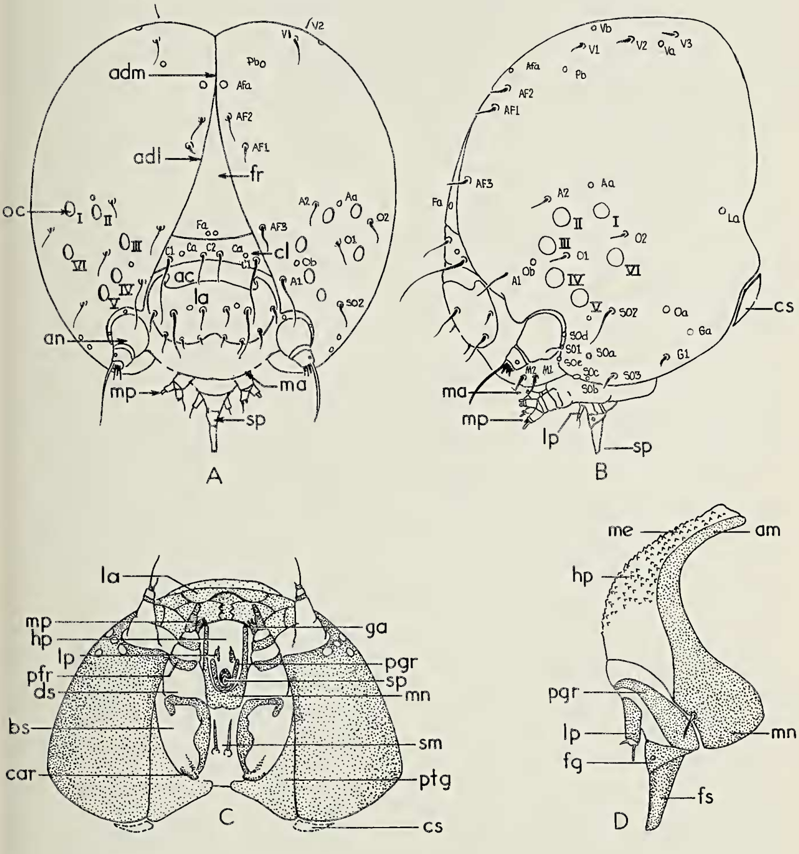

Fig. 2. A—B. Chaetotaxy of head capsule, first instar larva; A. Frontal view. B. Lateral view. C. Head capsule, fourth instar larva, ventral view. D. Hypopharynx, spinneret and associated structures, third instar larva, lateral view. Key to lined abbreviations: ac=anteclypeus, adl=lateral adfrontal suture, adm=median adfrontal suture, am=arm of mentum, an=antacoria, bs=basistipes, car=cardo, cl=clypeus, cs=cervical sclerite, ds=dististipes, fg=fusulus, ga=galea, hp=hypopharynx, la=labium, lp=labial palp, ma=mandible, me=maxillulae, mn=mentum, mp=maxillary palp, oc=ocellus, pfr=palpifer, pgr=palpiger, ptg=postgena, sm=submentum, sp=spinneret. Other lettering refers to specific setae, lenticles or ocelli.

Crumb (1929) found many positive differences in the arrangement of the head setae and punctures in different species of Noctuidae, with a strong tendency toward generic homogeneity. The same author cautions, however, that the degree of individual variation necessitates the examination of a series of specimens before positive conclusions are drawn. In the discussion below of the setae and punctures, the "normal" position or arrangement is given only after numerous larvae of each instar were studied.

Chaetotaxy of the cranium: Even more than the cranium, larval chaetotaxy has afforded much discussion in the literature, often involved with attempts either to homologize or to compare the systems used in specific cases by various authors. Thus Peterson (1951) gives a table comparing names used by Forbes and Heinrich; Mutuura (1956) tabulates and compares the systems of Fracker, Gerasimov and Hinton with his own; and Hasenfuss (1960) compares the chaetotaxy systems of Gerasimov, Hinton and Bollmann. McKay (1963) discusses some problems and briefly compares certain setae of Mutuura and Hinton, but uses the system of the latter. The reader is referred to these authors for specific details on nomenclature and homology. We have used the terminology of Hinton (1946). For ease in following the discussion of the setae below, the reader is asked to refer to Figs. 2A, 2B and 3H. Setae and punctures of the left side only are discussed unless otherwise indicated.

Frontal (A) and Clypeal (C) Setae and Punctures: In the first and second instar the longest seta, C1, is found in the lateral angles of the isosceles triangle formed by the lateral adfrontal sutures. Just medial to C1 is a puncture, here called Ca, not mentioned by Hinton. About two thirds of the way to the midline from C1 is another seta, C2, slightly shorter than C1. Above C2 on the frons but nearer the midline is a puncture Fa. No other setae or punctures are found within the triangle on the first or second instars. With each succeeding instar Ca is proportionately nearer C1 than C2.

Another, smaller, clypeal seta is found on the third instar just medial to Ca. Anywhere from one to four additional setae may be found above the frontal puncture and within the triangle.

Three clypeal setae not found on the first instar are found on the fourth instar between C2 and Ca. Their position is variable within this area and some of them may be absent. As few as six and as many as eleven setae may be present above the frontal punctures and within the triangle on the fourth instar.

Adfrontal Group (AF): In the first instar lateral to and paral-

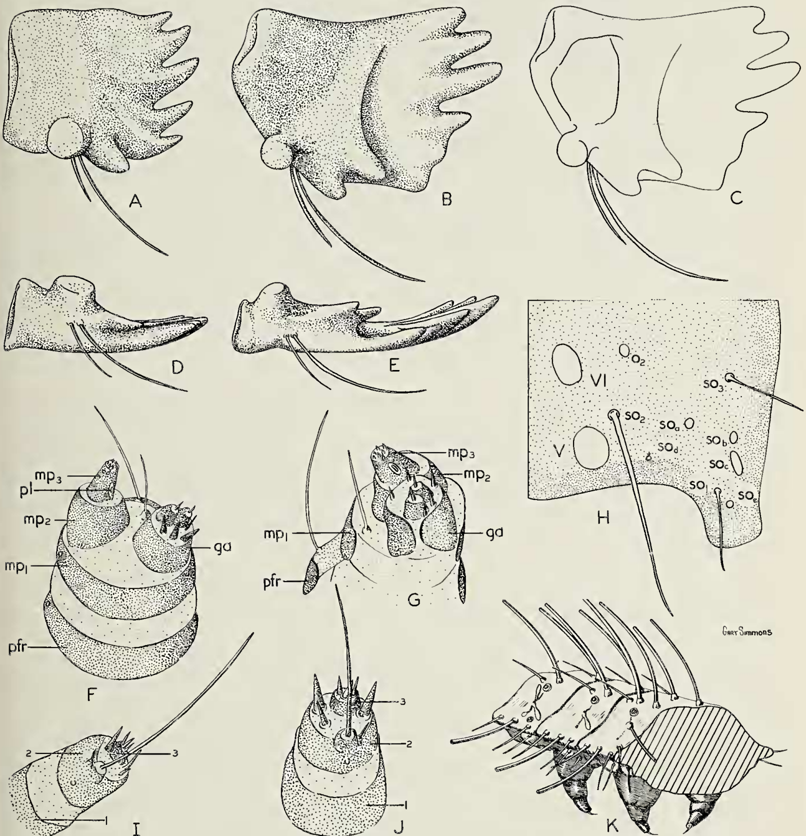

Fig. 3. A—E. Right mandible; A. First instar, oral aspect. B. Fourth instar, oral aspect. C. same, line drawing of optical section. D. First instar, edge, posterior aspect. E. Fourth instar, edge, posterior aspect. F—G. Maxilla; F. Left maxilla frontal-dorsal view. G. Right maxilla frontal-dorsal view. H. Chaetotaxy of the left subocellar area, head capsule, first instar larva. I—J. Antenna, frontal-lateral view. I. Fourth instar. J. Second instar. K. Schematic section through meso-thorax of first instar larva showing lateral ridge and position of major setae on several adjacent segments.

ling the lateral adfrontal suture are three setae and a puncture. These are called respectively from the lower-most to the upper-most; AF3, AF1, AF2, and AFa. The setae are roughly equal in length with AF2 sometimes shorter. AF3 is usually found on a horizontal line with the frontal punctures Fa. AF2 and AFa are variable in relation to one another and have been found with their positions reversed on later instars. No change in arrangement and no additional setae or punctures are found within the area of this group on any of the succeeding instars.

Anterior Group (A): Two setae and a puncture make up this group on the first instar with the longer seta (A1) just above the antenna. A2 is caudal to A1 and is about one-fifth to one-fourth its size and is associated with ocellus II. The puncture Aa is caudal and somewhat lateral to A2. It is more closely associated with ocellus II in the first instar than in later instars.

Puncture Aa is about equidistant from ocellus I and II in the second and third instars, but on the fourth instar it is usually closer to ocellus I. An additional seta is found within this group in some third instars. In individuals of the fourth instar as many as three additional setae may be found.

Ocellar Group (O): The ocellar setae are about equal in size. Seta O1 is usually equidistant from ocellus II and III. Seta O2 is caudal to O1 and ocellus I, but usually nearer to ocellus VI. Puncture Oa is caudal to ocellus V and below ocellus VI, but with each succeeding instar takes a more caudal position with respect to the latter.

Rarely there is a third seta just caudal to ocelli IV and V on the third instar. This additional seta is constantly present on fourth instars.

Subocellar Group (SO): On the first instar SO2 is the longest seta of this group and is located just behind ocellus V. It is slightly longer than seta A1. Seta SO1 is found just lateral to the antenna between two punctures, SOd and SOe, and is a third to half the size of SO2. Seta SO3 is caudal to SO2 and is about equal to it in size. There are five punctures in this group, but only SOa is named by Hinton. This is located below SO2. The others have been mentioned in relation to SO1; the other two, SOb and SOc, which are closely associated are located below SOa. Puncture SOc is peculiar in shape and is much longer than wide in comparison with other punctures. It is very constant in position and may have taxonomic significance. Apparently most larvae in the Lepidoptera do not possess this puncture, at least it is lacking in most figures and illustrations.

The second instar has the same arrangement as the first. Additional subocellar setae variable in number and position can be seen on the third and fourth instars.

Lateral (L) and Genal (G) Setae and Punctures: On the first instar puncture La is considerably behind ocellus I. Seta G1 is a very minute seta located on the gena. Behind G1 and above it

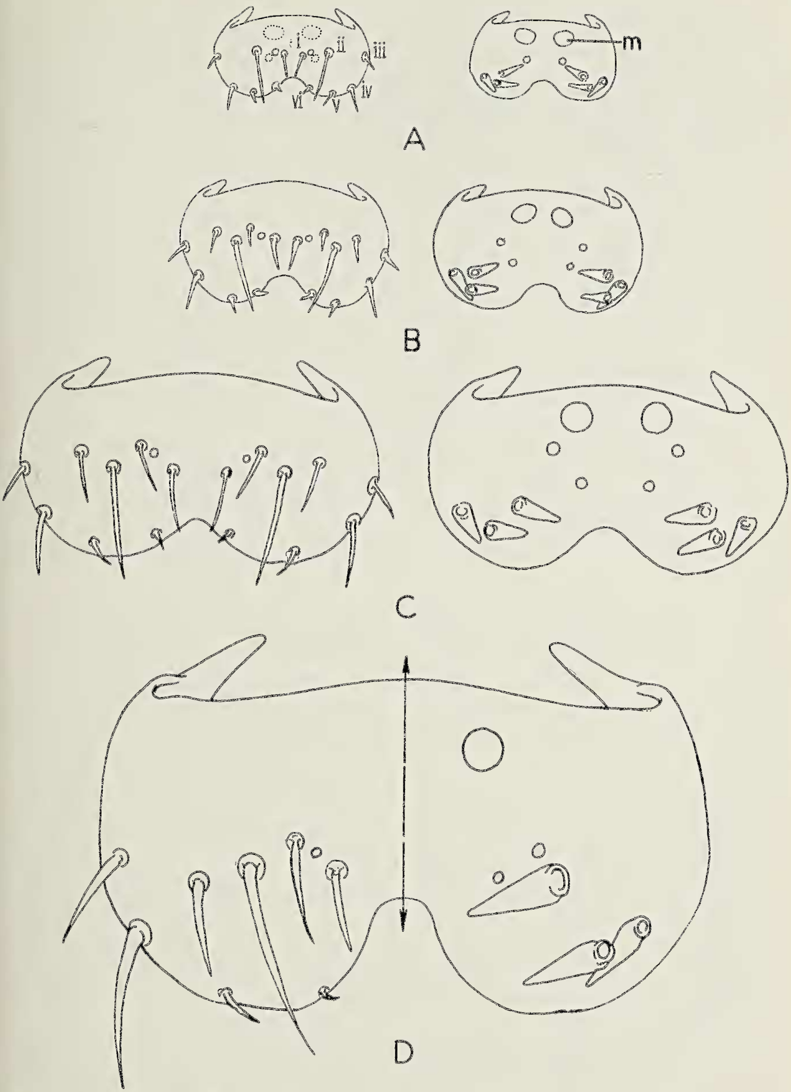

Fig. 4. A—D. Labra of larvae, showing setal pattern, facial aspect on left and oral aspect (epipharynx) on right of page. A. First instar. B. Second instar. C. Third instar. D. Fourth instar right half of labrum only.

is the puncture Ga. The distance between GI and Ga is quite variable, but positional relationships are constant.

No additional lateral or genal setae and/or punctures are found on the later stages. The distance between G1 and Ga on the third and fourth instars is much more constant, however.

Posterior Group (P): Hinton's posterior group is made up of two setae and two punctures, but only one puncture of this group is found on *E. comyntas.* This particular puncture is called Pb and is so closely associated with the setae and punctures of the vertex that it would seem to belong to this group. Puncture Pb is found on all instars in the same position.

Setae and Punctures of the Vertex (V): Behind Pb and extending caudally is a group of three setae and a puncture; V1, V2, Va, and V3 in order. The setae are all minute and about the same size as G1. They are constant in position on all instars. Medial to V1 and V2 is a puncture for which Hinton shows no homology unless it represents a puncture formerly belonging to the adfrontal or posterior group, which has migrated in a caudal direction. It is here considered as Vb.

Appendages of the Head. The Labrum, Epipharynx: the labrum, Fig. 4A to 4D, does not differ greatly from that of any other lepidopterous larva. It is notched, but this is not unique and the depth of the notch is subject to considerable individual variation.

The typical first instar labrum bears six pairs of setae on its facial surface (see Fig. 4A) and three pairs of broader more bladelike setae on the oral surface, more properly termed the epipharynx. (Unless otherwise indicated the setae and punctures in the following discussions are those of the left side only.) The setae are labeled following the system used by Forbes (1911). Seta *i* is located on the labrum near the midline, about halfway between the distal margin and the anteclypeus. A puncture is found lateral to, and somewhat behind, seta *i*. Setae *ii* is the longest seta of the group and is located lateral to seta *i*. Of the four marginal setae, seta *iii* is the most posterior of the series and is on the lateral margin; seta *iv* is the longest of this group and setae *v* and *vi* are both subequal to *iii* and are the smallest in the series.

The arrangement of the setae and punctures on the labrum of the second, third, and fourth instars is the same except the possible inclusion of one or two additional setae in the fourth instar.

The first instar larvae has one, and the other instars two, punctures on the epipharynx. The blade-like setae do not vary in structure and change but slightly in position between instars. The apices of these peculiar structures are directed toward the mid-line and when seen from below, appear to project slightly into the pre-oral cavity. Each appears to have a circular clear

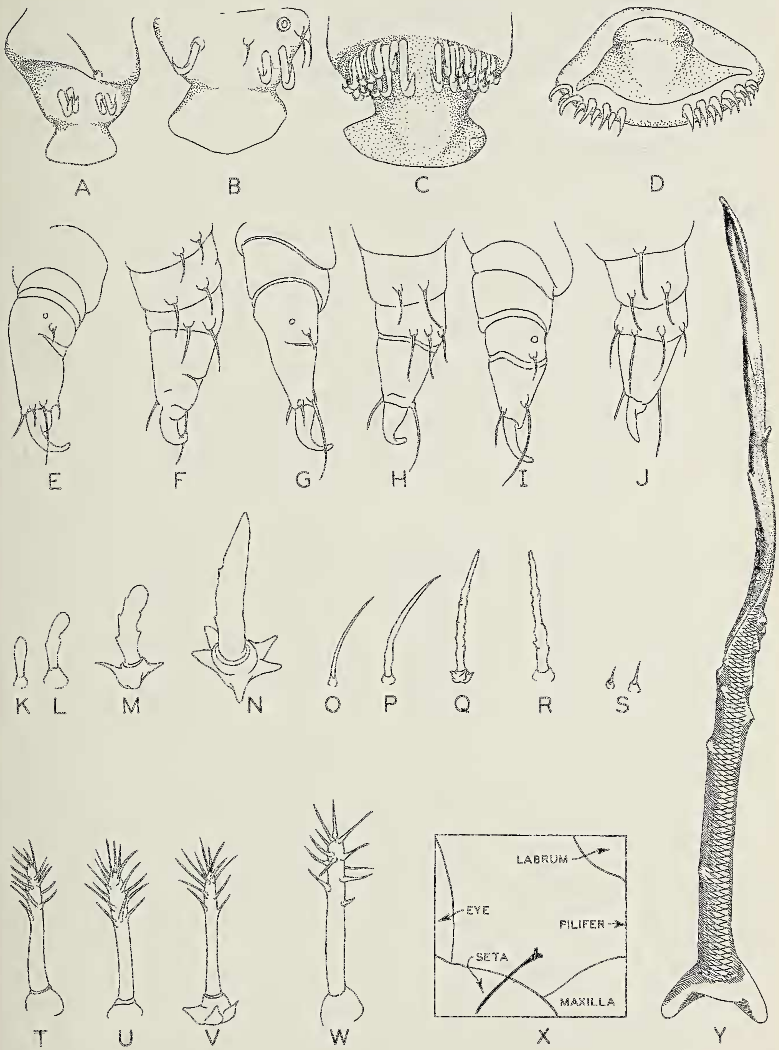

Fig. 5. A—D. Distal prolegs of larvae showing arrangement of crochets; A. Medial view of proleg, first instar. B. Medial view, anal proleg, first instar. C. Medial view of proleg, fourth instar larva with fleshly spatulate lobe below crochets. D. Ventral view of same. E—J. First instar Thoracic legs; E, G, I, lateral views of left pro-, meso- and methathoracic legs. F, H, J, medial views of right pro-, meso- and methathoracic legs. K—N. Type G setae from first (K), second (L), third (M), and fourth (N) instar. O—R. Longest seta on dorsum of fourth abdominal segment from first (O), second (P), third (Q), and fourth (R) instar larvae. S—microsetae from first instar larvae. T—W. Spiculate setae from second (T), third (U), and fourth (V) instar larvae and from the pupa (W). Y—example of major seta from head of pupa from location shown in X.

area near, but not at the base, which perhaps represents the internal out-pouching of the integumentary wall. The function of these setae is unknown, but they would certainly appear to be useful in holding or helping direct the food between the mandibles.

A pair of muscle scars (marked "m" in Fig. 4A) are prominent features of the proximo-mesial surface of the epipharynx.

The Antennae: The antennae (Figs. 2A and 2B, 3I and 3J) do not differ radically from those of any other lepidopterous larva. They are located on the head, ventral and medial to the ocelli. Ferris (1943) pointed out that the antennae of lepidopterous larvae have lost their point of articulation with the antennal segment and arise from a basimandibular membrane, no longer within the boundaries of the sclerotized cranium. In *E. comyntas* larvae, the bases of the mandibles and antennae are in close proximity and the latter often remained attached to the former when they were teased from the cranium. The membranous area at the base of the antennae is called the antacoria. From the antacoria arise the three main segments which comprise each antenna. On the second segment are a long and a short seta, two conical projections, and one small seta-like projection. A puncture is located on this segment midway between the long seta and the proximal margin of the segment. On the third segment there is one conical projection and two smaller seta-like projections. A very minute projection, not easily seen, is also located on the third segment.

Dethier (1941) pictures a larval antenna of *E. comyntas*. The only differences noted between his drawing and our specimens are that the small seta on the second segment is much larger, and the seta-like projections are much smaller than the corresponding structures on the specimens examined during this study.

Measurements were taken to determine the antennal lengths of the various instars. Exclusive of the long seta and including only the three segments, the lengths in microns were: first instar, 16.6; second instar 32.2; third instar, 51.6; and fourth instar, 100. The lengths in microns for the long seta were 58.2, 74.6, 100, and 161 microns respectively.

There is some variation in antennal length between individuals of the same instar, and also, a degree of variation in ratios of component segments of the antennae between instars. Segment 2 became proportionately longer than segment 1 and 3 with each succeeding instar.

The Mandibles: The mandibles, Fig. 3A to 3E, have anterior and posterior articulations with the head capsule. The former occupies most of the flattened region on the side of the mandible opposite the incisor edge. The posterior articulation is by means of a rounded, knob-like condyle which is a convenient landmark on the posterior mesial edge of the mandible. The first instar mandible (Fig. 3A) has sixth teeth, the most posterior of which is somewhat elevated and associated with the condyle. From the latter prominence a ridge, or retinaculum, runs across the mandible to the anterior surface. Sclerotized crests run from the teeth to the retinaculum and, particularly with the second and fourth tooth from the posterior end, give the impression of distal linear folds. Two setae, one long and one short, are present on the posterior lateral margin. Later instars (Fig. 3B) have seven teeth, the distal incisor points varying somewhat in shape. Three of the middle points are almost finger-like, while the more anterior and posterior teeth in the series may be reduced and blunted.

It would appear that the retinaculum becomes gradually elevated in progressive instars, particularly along the posterior parts of the mandible. Teeth are either incorporated in this retinaculum (the most posterior tooth in the first instar mandible appears closely associated with the prominence) or develop there, so that the retinaculum of the fourth instar larva is characterized by two prominent teeth. The appearance and ontogeny of these structures is best seen in Figure 3D (first instar) and 3E (fourth instar). The two molar teeth are suggestive of the basal molar parts observed in mandibles of some Coleoptera. They are at a different level than the dentation of the distal margins.

Of some interest is the fact that Crumb (1929) noted that decided peculiarities in the mandible were "invariably associated" with a wide departure in position and arrangement of setae and punctures on the head. We were not able to notice any such correlated anomalies.

A little degree of orientation may help the reader in locating the next four head appendages. If the head capsule of a fourth instar larva is viewed from the ventral surface (Fig. 2C) a pair of maxillae are conspicuous on either side of a centrally located labium. Closer inspection of the maxillae shows four distal sclerotized rings, the three most distal of which are the maxillary palps. Actually the terminal portions make up an outer palpus. There is a less conspicuous inner lobe of the palpus (the galea) on the dorso-mesial surface. Details of these structures are given below. The fourth sclerotized band from the tip of the maxillae is the palpifer. The latter attaches to the stipes, the distal parts (dististipes) of which are membranous. The proximal area of the stipes is outlined on its distal and mesial extremities by a sclerotized band. The proximal arm of this band points to a small triangular sclerite, on the posterior-mesial surface of the cardo. The latter segment is rather membranous and appears to lie obliquely to the stipes, between the latter and the postgena.

Between the maxillae, on a line between the palpifers, is the spinneret. Since it points ventrally, it is not as apparent in this view as the sclerotized rings at its base. The lighter sclerotized ring completely surrounding the terminal part of the spinneret is the fusuliger. Lateral to it, sclerites of the palpiger can be seen running to the small pair of labial palps. The palps are anterior and lateral to the spinneret. The membranous area in front of the labial palps is the hypopharynx.

Posterior to the spinneret, between the dististipes, is a dark sclerite, the mentum. This envelopes the posterior portions of the spinneret, and lateral arms run anteriorly on either side of the hypopharynx. The submentum is membranous and is just posterior to the mentum between the basistipes.

The Maxillae: The maxillae, Figs. 3F and 3G (stipes not shown), vary but little between instars in structure. The stipes, Fig. 2C, particularly the sclerotized portions, shows the most variation in respect to setal pattern. On the first and second instars there are two long setae on the stipes with a puncture between. A variable number of setae are located on the third and fourth instar stipes, but always more than two.

The punctures on the maxillae are constant in position and number. One puncture is found laterally on each of the two proximal segments of the maxillary palpus (mp). They are barely visible on Fig. 3F. Two puncture-like structures are located distally on the frontal surface of the third segment of the maxillary palpus, and proximally there is a sensory plate (sensillum placodeum pl. on Fig. 3F), which is just opposite the galea. The galea (ga) has a puncture on the ventral surface.

The Labium: The labium, Fig. 2D, although variable in size, does not differ in structure or setal pattern on any of the instars. The labial palps (lp) are distinctly three-segmented in most other lepidopterous larvae, but appear to be only two-segmented in *E. comyntas*. The basal segment of the labial palpus is roughly equal to the fusuliger (fg) of the spinneret in height. In most specimens it is one third and never more than one half

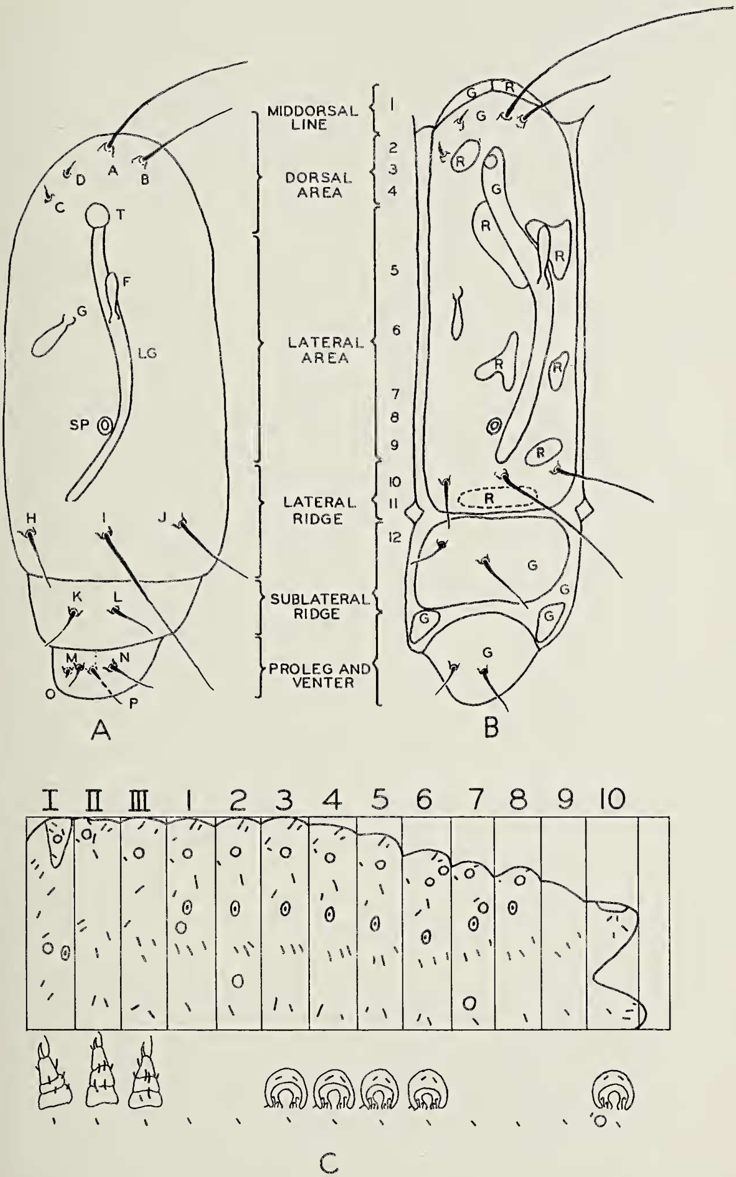

Fig. 6. A—B Diagrammatic drawings of the fourth abdominal segment of a first instar larva, left side: A. Position of setae and lenticles; LG=lateral groove (furrow), SP=spiracle. For explanation of other lettering see text. B. Color pattern; R=Red, G=Green; 1-12=areas of color. C. Setal map, left side of first instar larva; thoracic legs, prolegs and setae on the ventral side are shown at bottom of drawing.

the height of the fusulus (fs) as measured on its posterior aspect. The palpiger (pgr) bears no setae, but on the distal border of the mentum (mn) there is a pair of setae located one on either side of the spinneret. The two arms of the mentum extend alongside the paraglossae (me) anteriorly and then abruptly curve in a dorso-caudal direction. The paraglossa bears many spine-like processes which are somewhat larger than those on the hypopharynx (hp).

The Spinneret: The spinneret, Fig. 2D, is made up of an elongated fusulus (fs) and a wedge-shaped base called the fusuliger (fg). Except for a pair of punctures on its anterior surface the spinneret has no vestiture. The structure of the spinneret is the same in all instars. The measurements of the spinneret vary considerably within an instar, but the ratio between the length of the spinneret and labial palp fall in approximately the same numerical range in all instars, 2.3 to 3.4. Crumb (1929) found the spinneret varied considerably between genera of noctuid moths, particularly its relative length compared to the basal joint of the labial palp, as well as characters of the tip.

The Hypopharynx: The hypopharynx, Fig. 2D, forms the floor of the mouth and is flanked on either side by the fleshy lobes of the paraglossae (me). It begins as a raised, broad, flattened area anterior to the labial palpi. Its anterior spiny area in the mouth could be called a lingua, but posteriorly in the mouth cavity it narrows and forms a sort of trough between the paraglossal lobes. Small slender projections are sparse at the anterior and become more numerous posteriorly just before the trough. No noticeable differences occur in the hypopharynx between any of the instars.

BODY OF THE LARVA. *The Neck*: The neck is long and retractile into the prothorax. Except for a pair of cervical sclerites it is membranous. The sclerites (Fig. 8G) are located in the lateral areas of the anterior portion of the neck. There are only slight differences between the sclerites of individual instars except for gradual increase in size.

Setal Types: Four main types of setae were found on the first instar larva. The first type, here referred to as major setae, are all rather long, finely serrate, and have pointed tips. Examples of major setae are shown in Fig. 5O to 5R, and 5Y, and the location of specific setae on a particular segment is shown on Fig. 6A. All setae on the latter figure, and in the following discussion, are designated by letter. On Figure 6A, the following are major setae, A, B, H, I, J, K, L, M, N and P. Seta A on abdominal segment 4 was 258 microns in length.

Lesser setae, see Fig. 5S, are similar to the major setae structurally but differ in size; for example, D on abdominal segment 4 is 9.7 microns. A third type, here designated microscopic setae, are very minute and not easily seen. They are usually located anteriorly on each segment and are often hidden in the folds between segments. Seta C on the dorsum of the second abdominal segment measures 4 microns. Seta O is ventral in location and is the only other seta of this type given a letter symbol. No serious attempt was made to locate the microscopic setae on succeeding instars.

A fourth type of short stout setae is represented by setae G and F. These will be called pegged setae, see Fig. 5K to 5N. Both G and F are clavate and short. Seta G on abdominal segment 4 was found to be 29 microns.

Drawings of the longest major seta on the dorsum of the fourth abdominal segment on each instar and on the pupa are shown on Fig. 5O to 5R and 5Y. Here it can be noted that the only difference is a slight increase in diameter and length as follows: first instar, 258 microns; second instar, 343 microns; third instar, 386 microns; and fourth instar, 386 microns. In sharp contrast is the length of this seta on the pupa, 644 microns. The setigerous tubercle on the pupa (Fig. 5Y) is always smooth and wider than tall. Contrary to what might be expected these setae are not proportionally larger with each succeeding instar as is the case with the spiracles on the larvae, which roughly follow a geometric progression in size with each succeeding instar. A pointed projection is sometimes found on the side of the setigerous tubercle of the larvae, giving the prominence a starlike appearance from above. Little correlation could be noted with presence or absence of these projections on the tubercles and particular types of setae (except in the spiculate setae discussed below); for instance, the tubercles of 5L and 5M and 5Q and 5R.

Many pegged setae are present on the second instar. They tend to be concentrated in the lateral area of all segments though in no recognizable or consistent pattern. Their setigerous tubercles have either one pointed projection or none. Fig. 5L shows one of these setae on the fourth abdominal segment. Its length is 48.4 microns. Similar setae are found on the third and fourth instars but the number of projections on most of the setigerous tubercles is four or more. These pegged setae on the third instar are merely blunt at the end rather than clavate. Fig. 5M shows one of this type on abdominal segment 4, which measures 71 microns. Similar types on the fourth instar are more pointed.

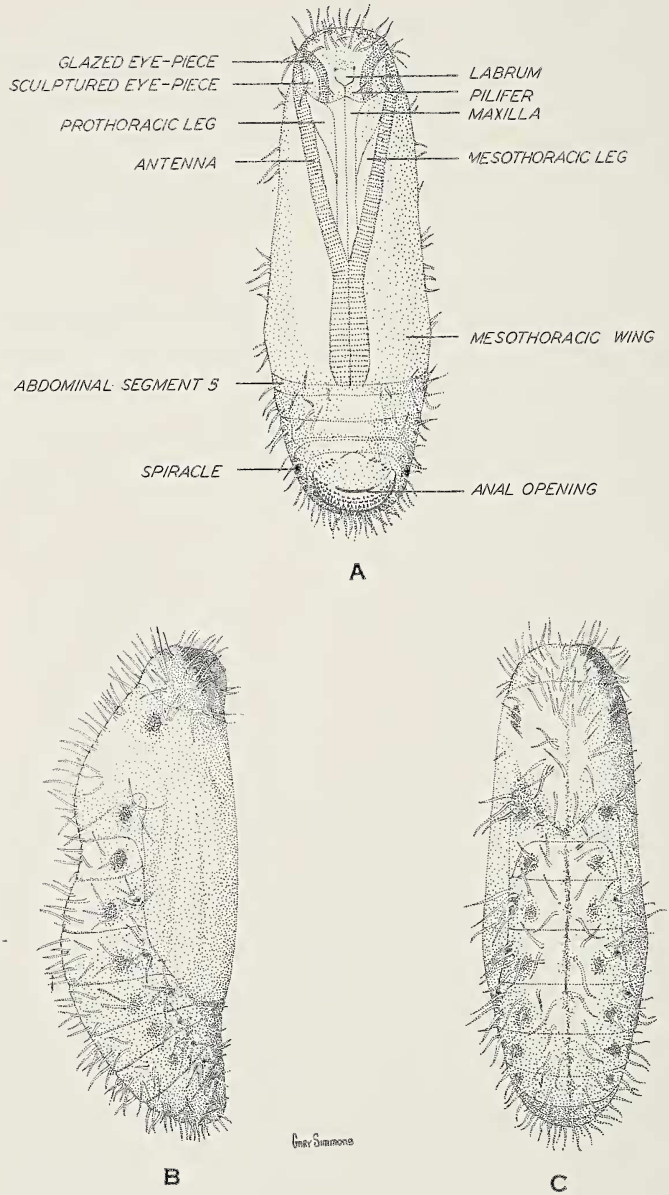

Fig. 7. A—C. Pupa, showing setal pattern and sclerites; A. Ventral view. B. Lateral view. C. Dorsal view.

Fig. 5N shows one on the fourth abdominal segment which measures 100 microns. No pegged setae were found on the pupa.

A fifth setal type here called a spiculate seta (Fig. 5T to 5W) is not found on the first instar. It differs from the other types in that tiny spicule-like projections occur on the distal third of the seta. At low magnification these distal projections give the impression of pine trees, see Fig. 8I and 8J. Spiculate setae on the second, third, and fourth instar larvae have the same length and apparently the same number of spicule-like projections. Spiculate setae on the second instar are located only near the honey gland. Those on the fourth instar differ in that their setigerous tubercles have pointed projections, whereas the setigerous tubercles of the second instar spiculate setae are smooth. The fourth instar larvae has spiculate setae on other areas of the body in addition to their normal position. On one specimen they occurred near the second abdominal spiracle and on another they were near the first abdominal spiracle. Length measurements in instars 2 to 4 are: 101.3, 103.3, and 93.6 microns respectively. Measurement of a spiculate seta on the pupa is 116.3 microns. Again it can be seen that size of a particular type of seta could not be correlated with the increase of size of other structures in succeeding instars.

From the above discussion of setae, it can be judged that there is considerable variation in number, kinds, size, and location of these structures from one instar to the next. In addition, there is variation in setal pattern (except in first instar larvae) between different individuals in the same instar. The short more or less clavate setae are the most variable in position, but the spiculate setae, though often found near the honey gland, may also occur on other areas of the body.

Setal Map of the First Instar Larva: The body of the larva is covered by many tubercles, each of which may or may not bear a single seta. Tubercles not bearing setae are here called lenticles, and when the word seta is used the fact that it is in all cases borne on a tubercle is understood. Certain of the setae and lenticles show a definite pattern of arrangement on all instars. The pattern is best seen on the body of the first instar larva (Figs. 1C, 1D) and is indicated on the setal maps (Figs. 6A, 6C). The extreme "hairiness" of the later instars makes setal maps impractical.

The map (Fig. 6C) shows the left side of a first instar larva. Roman numerals designate thoracic segments, and arabic numerals the abdominal segments. Large circles represent lenticles and short lines represent setae. The left thoracic legs are shown below the map from a medio-ventral view, and the prolegs from a ventral view. A prothoracic shield on the dorsum of the prothorax and an anal plate on the dorsum of the ninth and tenth abdominal segments are indicated on the map. Figure 6A is an enlarged partially schematic view of the fourth abdominal segment. Setae are indicated by letters of the alphabet. Setae on other segments are given the same letter as those on the fourth abdominal segment having a similar position. Not all setae could be designated in this manner, especially those of the prothorax and the ninth and tenth segments.

A furrow (LG, Fig. 6A), is present on each segment starting on the dorsum and passing posterior to the edge of the dorsal lenticle and just posterior to the spiracle and ending in the vicinity of the lateral ridge. This furrow varies only slightly from segment to segment. Although it is a convenient landmark, the furrow is not shown on the setal map, Fig. 6C.

In plotting a setal map, the rectangles are drawn first, and setae and lenticles are then added. For convenience, the rectangles are made equal in size, with the result that horizontal distances are sometimes not in proper proportion. This would occur when some segments, for example, the prothorax, is much wider than another segment. Its setae would nonetheless be placed in the same horizontal distance as a subequal segment. Vertical distance, on the other hand, is easier to indicate on the map, and except for slight distortion of spatial relationship at the dorsal surface (top of the rectangle), the setae are in their proper relative positions.

Except for the prothorax all segments of a first instar larva are about equal in width (see Fig. 1C, 1D). All segments from the mesothoracic to the third abdominal segment are roughly the same height. Although somewhat schematic, Figure 3K gives the cross-sectional shape of the first instar larvae.

Terminology used to designate setae and their location is partially that of Clark and Dickson (1956). The reader is referred to the typical segment drawn on Fig. 6A, where the following main regions are labeled. Some of the regions, i.e., the lateral ridge, might be more distinctive in Fig. 3K. The area between the mid-dorsal line and the lower edge of lenticle T is called the *dorsal area.* That between the lower edge of the spiracle and lenticle T is referred to as the *lateral area.* The ridge below the spiracle is called the *lateral ridge* and the ridge below this is called the *sublateral ridge.* The leg or proleg is below

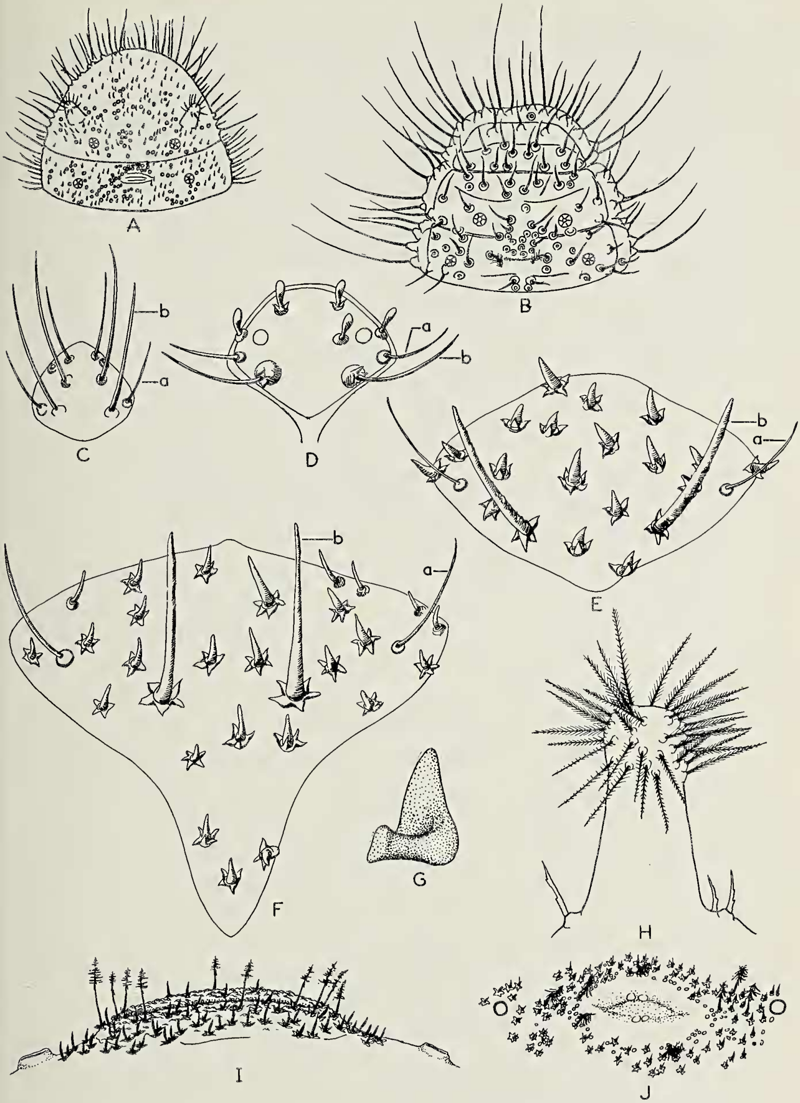

Fig. 8. A—B Dorsal view of honey gland and eversible tubercles; A. Abdominal segments 7, 8, and 9 in fourth instar larva, showing position of organs in relation to each other and spiracles. B. Same, second instar larvae. C—F. Dorsal view of prothoracic shield of first (C), second (D), third (E) and fourth instar larvae. Setae *a* and *b* can be traced ontogenetically by structures at their base (see text). G. Cervical sclerite, 3rd instar larva. H. Lateral view of extended eversible tubercle from fourth instar larvae. I. Partially schematic anterior view of honey gland of fourth instar larva. Clusters of spiculate setae are prominent around the gland; the inverted tubercles on segment 8 appear on each side. J. Dorsal view of same.

the sublateral ridge. Where neither proleg nor leg occur on a segment, the area below the sublateral ridge is called the venter.

The following section is a description of the specific setae and lenticles on each segment of the first instar larvae and on the prolegs. Only the setae for the left half of the larvae are mentioned. Later instars are not treated in as much detail as the first.

Prothorax: A prothoracic shield, Figs. 8C to 8F, is located on the dorsum of the prothorax. It is roughly diamond-shaped with the anterior corner being so rounded as to make the anterior half approach a semicircle in shape. A major seta is located near the anterior corner just to the left of the mid-dorsal line on the shield. Slightly posterior and somewhat ventral to this seta is a lenticle lying just inside the margin of the shield. Posterior to and above the lenticle is another major seta. On the posterior half of the shield are located two more setae; the first on the posterior margin of the shield near the lateral corner and the second dorsal and slightly posterior to the first. The ontongeny of certain structures on the shield is discussed below.

The bases of four setae on the lateral surface of the prothorax describe a diagonal line parallel to the anterior margin of the shield. The most posterior of the group is located just below the lateral corner of the prothoracic shield. Two other setae together with a lenticle and the prothoracic spiracle respectively describe another diagonal on the lateral ridge with the spiracle near the intersegmental line. Two more setae, one anterior and dorsal, the other posterior and ventral, are located on the sublateral ridge. These have been designated K and L respectively and both occur also on the other thoracic segments and on abdominal segments 3, 4, 5 and 6. Near the midventral line is a seta here called P that is repeated on all segments. This occurs on every thoracic and abdominal segment and is indicated by the lowest setal symbol on the map Fig. 6A.

Mesothorax: Six dorsal setae and a lenticle are present. Just to the side of the mid-dorsal line on the anterior third of the segment is a major seta and ventral to this a lenticle called T. A lenticle in roughly this same relative position is found on the methathorax and the first eight abdominal segments. A microscopic seta C is found anterior and slightly ventral to this lenticle and varies in position vertically up and down in front of the lenticle on the metathoracic and first eight abdominal segments. In a ventral and slightly posterior position is found another major dorsal seta. Posterior to the intrasegmental furrow and midway between the lenticle and dorsal midline are two more major setae. The anterior one is called A and the posterior B. This pair of setae is found to be present on the metathorax and first six abdominal segments. A group of four setae is found on the lateral ridge. Setae K, L, and P, are also present.

Metathorax: Setae A, B, C, K, L, and P, and lenticle T are present. A pegged seta G is found midway between the lenticle and the lateral ridge. Four other setae are present on the lateral ridge.

Abdomen: First Segment. Setae A, B, C, G, L, and P, and lenticle T are present. A lesser seta called D is found just dorsal to C. Anterior to the furrow and situated midway between the dorsal lenticle and the spiracle is a pair of pegged setae. The anterior is G, and the posterior, F. Both are found together on the first six abdominal segments, and on other segments F appears to be in the furrow. A lenticle is present below and just anterior to the spiracle and not quite on the lateral ridge. The three setae present on the ridge are designated from the most posterior as H, I, and J. This group is found on the first nine abdominal segments.

Second Segment. Setae A, B, C, F, G, H, I, J, and P are present in their normal positions. A lenticle is present dorsal to, and somewhat posterior of, seta L, which is the only seta on the sublateral ridge. Seta D could not be found.

Third Segment. Setae A, B, C, D, F, G, H, I, J, K, and P are present in their normal positions though C is dorsal as well as anterior to lenticle T. Three major setae are present on the proleg; an anterior lateral seta called M, a posterior lateral seta called N, and on the medial side of the proleg a seta P. A microscopic seta (O) is located in an anterior position on the medial surface of the proleg. The setal pattern on the other prolegs is the same except that O could not be located on the anal proleg.

Fourth Segment. All setae found on abdominal segment 3 are found on abdominal segment 4 in identical positions.

Fifth Segment. Other than D, which could not be found on this segment, and the fact that C is directly anterior to lenticle T instead of dorsal, this segment is identical in vestiture to abdominal segment 4.

Sixth Segment. A lenticle called S located dorsal and posterior to lenticle T makes its appearance on this segment. In other respects the segment is identical in vestiture to abdominal segment 4.

Seventh Segment. Lenticle S is located dorsal and anterior to lenticle T on a vertical line with the spiracle. Both lenticles are posterior to the furrow. K is absent. A lenticle occurs on the sublateral ridge. Setae O and F are present but the proleg setae M and N are not. Setae B and G are not present, but the remaining setae are as on segment 4.

Eighth Segment. Lenticle S is the only lenticle present. Present are seta A, C, H, I, J, L and P only.

Ninth Segment. Setae H, I, J, L, O and P are the only setae to be found on this segment. No spiracle or lenticle is present.

Tenth Segment. Four setae possibly "homotypic" with A, H, I, and J are located in a dorso-lateral position above the anal line. Four setae (undesignated) are located below the anus and above the anal proleg. Setae M, N, and P are present on the proleg. Two setae and a lenticle in addition are located anteriorly on the mesial surface of the proleg. A somewhat rounded rectangular anal plate makes its appearance on the dorsum.

Comparison with Other Lycaenid Larvae: Setal maps of *E. compyntas* and *Plebejus (Icaricia) icarioides* Bdv. were compared to see if there were any consistant differences. The purpose of this comparison was not only to discriminate the two species but possibly to gain some insight into generic differences in the immatures. The taxonomy of the above species was originally derived by use of adult characters.

The vestiture of the legs, prolegs, and prothoracic shield did not differ. The following is a summary of differences between the first instar larvae:

> Present in *E. comyntas* and absent in *P. icarioides*: Seta D on the sixth abdominal segment and lenticle 7 on the seventh abdominal segment. Structures present in *P. icarioides* and absent in *E. comyntas*: Setae K and F on the mesothorax; seta G on the seventh segment and lenticle S on abdominal segments 1, 2, 3, 4, and 5.

With the limited material on hand (cast skins only), it was possible to make maps of only the first six abdominal segments of the first instar larva of *Plebejus (Lycaeides) melissa* Edw. There was nothing on the specimens examined to suggest that they were different from *P. icarioides.*

A first instar larva of *Strymon melinus* Hub. differs from both *Everes* and *Plebejus.* Setae G and F are not clavate in the former species and dorsal lenticles S and T are very close together. A lenticle is present between K and L on abdominal segments 3, 4, 5, and 6, while no lenticles are found in these locations on

E. comyntas, P. icarioides or *P. melissa*. The prothoracic shield of *S. melinus* differs in that it bears an extra pair of setae. The anal plate is longer than wide, roughly oval in shape (with the broader portion anterior) and has two punctures on the posterior half.

Prothoracic Shield: The setae on the shield of the first instar have been described and figured (8C). The shield is defined on the second instar by a line, apparently a suture, enclosing a smooth green area. In contrast the surrounding area is granulated. The suture is less easily observed on the third and fourth instars, but the parts of it that are distinguishable enclose the area which, though green and therefore distinguishable on the living specimen, is granulated like the surrounding skin. Whereas the prothoracic shields of the first instar larvae of *E. comyntas* and *P. icarioides* are relatively similar, later instars of the two species seem to differ more markedly. Other species, for example *S. melinus*, bear additional setae on this structure in the first instar. It is presumed that the prothoracic shield may be of some interspecific taxonomic importance.

In spite of the great increase in the number of structures on the prothoracic shield in later instars (see Fig. 8D-8F), some setae can be traced ontogenetically. This can be done partly by position and setal type, but also by structures at the base of the setae. The most posterior-lateral setae on each side of the first instar shield are each located on a distinct sclerotized area, the pinaculum. The latter are slightly larger than the base of a typical seta which elevation (tubercle) could be termed a papilla. The papillae are also present on these setae, marked "a" in Figure 8C to 8F. These very slender long setae represent a type not seen elsewhere on the larvae, even though it falls into a major setal category on the basis of its length. Another pair of setae, marked "b" in Figs. 8C to 8F, are more mesial on the shield, and are located on a prominence called a chalaza. The chalaza-borne setae "b" can be easily traced in the drawings. Mackay (1959) also found that the bases of the setae were useful in identifying particular setae in the Olethreutidae.

The second instar prothoracic shield bears a pair of lenticles which are "homologous" to those on the first instar. They are in a somewhat similar location. These lenticles may or may not appear on the third or fourth instar, and their position may also vary.

Clavate, blunt, or pointed pegged setae occur on the second, third, and fourth instar shields and are variable in number and position.

Blackish areas may be present on the shield. Some first instar larvae had a pair of blackish spots along a longitudinal line posterior to each of the lenticles, others had a posterior pair of wedge-shaped blackish areas on each side of the mid-dorsal line. These areas were also noted in second and third instar larvae. On others the entire prothoracic shield was green.

Anal Plate: The anal plate is located in the center of the dorsum on the tenth abdominal segment in first instar larvae. It is square in shape with rounded corners. The sides of the plate are approximately equal to one third the width of the segment. The plate is devoid of setae and is not granulated, but on one specimen a minute lenticle (or puncture) was seen on each lateral edge of the plate. The plate did not occur on later instars.

The anal plate of *E. comyntas* tended to approach a square in shape, while the anal plate of *P. icarioides* was hexagonal, being somewhat wider than long. This suggests that there may be some taxonomic usefulness in this structure.

Legs: According to Fracker (1915) "No one has yet discovered characters of much value in the structure of the thoracic legs, so uniform are they throughout the entire order." Comparison of the prothoracic leg of *E. comyntas* with the prothoracic leg of a larva of *Cirphis unipuncta* (Haworth) (drawing in Ripley, 1923) shows no significant difference in structure or setal pattern. Figures 5E to 5J, show the thoracic legs in the first instar larvae. No consistant difference between instars was noted.

Prolegs: There are five pairs of prolegs. Those located on segments 3, 4, 5 and 6 are referred to as the ventral prolegs and those on the last segment as the anal prolegs. Each proleg has a biordinal mesoseries of crochets interrupted in the middle by a fleshy spatulate lobe, see Figures 5A to 5D. This arrangement is diagnostic of the family Lycaenidae. There is generally the same number of crochets on each side of the lobe in each instar. Th average number of crochets on the proleg of the first instar is four (Fig. 5A); on the second, seven; on the third, fifteen; and on the fourth, twenty-three. The relationship between the fleshy lobe and the crochets in the fourth instar proleg is given in two views, Figure 5C and 5D.

The number of crochets per proleg is constant on the first instar larva, there being four on each ventral proleg and three on each of the anal prolegs (Fig. 5B). In later instars the number is subject to some variation between individuals of a given instar and even between members of a proleg pair. The average number for an instar, however, appears to remain fairly constant.

Lenticles and setae occur on the medial surface of the prolegs as well as on the lateral surface. The medial surfaces of the anal prolegs and of the fourth abdominal proleg were studied on each instar. There is always one lenticle on the medial surface of each anal proleg of the first and second instar larvae. (Fig. 5B). Two were found in this position on a third instar and three on a fourth instar. No lenticles occur on the medial surface of the fourth abdominal proleg of the first instar, however, two are present on the second and third instars and only one was found on a fourth instar specimen.

Setae on both surfaces of the prolegs become more numerous with each succeeding instar.

Honey Gland and Protrusible Tubercles: The honey gland and protrusible tubercles, see Fig. 8A, B, I, J, are found only in the later instars. Though the second instar larva does not have the tubercles, it does have a functional honey gland on the dorsum of the seventh abdominal segment (Fig. 8b). On the third and fourth instars in addition to the honey gland a pair of protrusible sacs or tubercles (Fig. 8H) are located posterior and somewhat lateral to the eighth abdominal spiracles (Fig. 8A). A spiculate seta is located on each of the lateral margins of the gland on the second instar. Along the posterior margin of the glandular orifice is a cluster of lenticles with no definite arrangement. The anterior margin does not bear setae or lenticles. The gland on the third instar has the same vestiture except the lenticles are more numerous and there are three spiculate setae at each of the lateral margins of the gland. Although there are more of these setae on the fourth instar honey gland, they are not arranged with an equal number on each side. For example, one specimen has four on one side and eight on the other.

When the protrusible tubercles on the third and fourth instar are extended, they can be seen to bear spiculate setae (Fig. 8H) on their distal parts. These setae are unlike other spiculate setae in that the spicules are shorter and are proximal as well as distal in position. When the tubercles are only part way protruded, the setae can be seen grouped in a vertical bundle in the center of the tubercle. When fully protruded the setae point in all directions. The tubercle is often fluttered up and down between these two positions making the setae appear to move by their own power. A count was made of the number of spiculate setae per tubercle on fourth instar larvae: They vary in number from 29 to 34 and may also be variable in numbers between members of pairs on one individual. The third instar seta measured 76 microns and the fourth instar about 112 microns. Other measurements of the gland and tubercles are given in Table 1.

Coloration: Three basic colors, brown, green and black, make up the color pattern of the larva. Black color, which is probably due to pigments in areas underneath transparent epidermis is found only on the prothorax. On the first instar larva this color was seen just anterior to the prothoracic spiracle in a depression above the lateral ridge. The border of the prothoracic shield and certain spots on the shield also showed this color.

When viewed from the side the larva appears to have at least twelve longitudinal alternating light green and brown areas. In gross examination these areas are not all obvious, so that the larvae may appear to have only a few anterior to posterior color stripes. When viewed under a microscope these appear as a linear arrangement of small pigmented patches. The larvae, however, are described in the following paragraphs as if the areas were not broken up into pigment patches. The fourth abdominal segment of a first instar larva is shown in detail in Fig. 6B to illustrate longitudinal areas of color. They have been numbered from one to twelve for ease in discussion.

There is some variation in the color pattern, although its basic nature probably is fairly stable. For instance, the lighter stripe marked by number two, in a particular premolt fourth instar larva was nearly obliterated by the enlargement of stripes one and three; ordinarily the stripe is well defined in a freshly molted fourth instar larva. It is possible that some color changes are due to increasing pigmentation during a particular instar. Variations in which the larva has dark green areas instead of brown or reddish-brown are about equally common and occur in siblings from the same female.

First Instar Larvae: Mid-dorsal Line. — This line (marked 1 in Fig. 6B) is dark brown and extends from the dorsum of the mesothroax to the dorsum of the ninth abdominal segment where the line broadens to cover most of the dorsal area. The tenth segment bears five alternating light green and dark brown transverse bands, the most anterior being light green.

Dorsolateral Area. — A broad light green stripe makes up this area extending from the prothroacic shield to the tenth abdominal segment. There is a hint of a fine dark brown stripe extending within the light green one, from abdominal segment 4, passing just dorsal to the lenticles and merging with the mid-dorsal line on abdominal segment 7.

Lateral Area. — This area is basically made up of five alternat-

TABLE 1

Measurements (in mm.) of the honey gland and eversible tubercle in larvae of Everes comyntas Godt.

Instar	No. Exam.	Gland Orifice Length	Gland Length	Gland Width	Tubercle Height	Diameter of base Extended Tubercle	Diameter of base Retracted Tubercle
4	5	256-372	370-549	204-256	255-362	155	154-179
3	5	154-256	282-384	128-204	155	--	77-128
2	5	102-154	256	102-128	-	--	--

ing reddish-brown and light green stripes extending the length of the body. The first of these lateral stripes (5) going in descending order is reddish-brown and starting just below the prothoracic shield it runs as far as the tenth abdominal segment where it merges with the last dark transverse band mentioned under the section on the mid-dorsal line. The second stripe (6) is light green and extends from the prothorax to the sixth abdominal segment. It is represented as haloes around the seventh and eighth abdominal spiracles and as small squarish patches on the ninth and tenth abdominal segments, the haloes and patches both being bordered by the merging first and third reddish-brown stripes. The third stripe (7) is dark colored and starts as a fine line just on the posterior edge of the prothorax and extends back to the eighth abdominal segment where it merges with the first and fifth dark reddish-brown stripes. The fourth stripe (8) is a broad light green band extending from the prothorax, where it merges with the light green stripe on the lateral ridge, to the fourth abdominal segment. It is represented by haloes around the fifth and sixth abdominal spiracles. The fifth stripe (9) is reddish-brown and extends from the mesothorax to the fourth abdominal segment where it becomes obscure.

Lateral Ridge. — The entire lateral ridge is light green except on the underside of the last four segments where it is dark brown.

Sublateral Ridge, Venter, And Prolegs. — These areas are entirely light green in color.

Second Instar Larvae. The second instar has the same basic pattern as the first instar with the following exceptions: Stripe number three begins on the mesothorax and ends on abdominal segment 6, the honey gland being light green in color is in this area. An area between the prothoracic shield and lateral ridge is reddish-brown except for a small light green stripe in the middle. Stripe number eleven extends from the second abdominal segment to the anus.

Third Instar Larvae. The color pattern is the same as in the second instar.

Fourth Instar Larvae. Same coloration as third instar only the dark stripes are broader and darker brown and the light stripes are greener. Other differences are as follows: Stripes number one and three nearly merge and the only remnant of stripe number eight is found as haloes around the spiracles. Stripe number eleven under the lateral ridge merges with stripe number twelve on the sublateral ridge which is also brown. Together they extend the length of the larva.

In addition to the above the lateral sides of the ventral prolegs are reddish-brown, the remainder being green. The entire anal proleg is reddish-brown. The venter is green.

THE PUPA

The obtect pupa of *Everes comyntas* is long and slender: average length of specimens examined was 6.7 mm.; average width at the widest portion was 2.5 mm. Thus the pupae are about three times as long as broad (not 4 to 1 as indicated by Scudder, 1889, vol. 3, p. 907). The ratio agrees with the length and breadth of the three European species of *Everes* figured by Lorkovic (1938). The average height at the highest point (3rd or 4th abdominal segment) was 2.4 mm.

The small size of the pupa, its slender profile, and the numerous long setae are fairly indicative of this species. These features are shown on Figure 7 a, b, c. The living specimen is whitish-green in color, with the head and thorax tending to be slightly darker green than the abdomen. A conspicuous mid-dorsal black line, while variable between individuals, extends from the prothorax to the seventh abdominal segment, where it fades out. The lateral and dorsal surface is speckled with many small dark brown to black spots. A lateral row of larger spots is also present just dorsal and slightly posterior to each abdominal spiracle. A larger spot occurs in a similar position on abdominal segment one, a slightly smaller spot on the metathorax and a still smaller dark area occurs on the mesothorax just posterior to the spiracle.

Reddish marks may be present in some individuals on both sides of the lateral lines on the abdomen.

Setae, Hooks, and Papillae. The major setae are basically white in color, so that as one observes a pupa he notes first its greenish color and shape and is subsequently cognisant of numerous long setae on the dorsal and lateral surface. These setae have been stippled on the drawing on Figure 7 in hopes that their unobtrusive nature may be imparted. In addition to the completely white setae, some are colored with one or more dark brown or black bands variously located at the base, tip or intermediate positions.

Most of the setae on the pupae are major setae, but a few on the venter of the abdomen are small in comparison with the others. The size of the smallest on one specimen was 43 microns. Since there was a difference in number between groups of setae on one side and the corresponding groups on the other, and between individuals, the taxonomic value of setae numbers is vague.

Spiculate setae are found on the prothorax and sixth abdominal segment only. They are one third to one quarter the size of the major setae covering most of the pupa. Those on the prothorax were not constant in number although they do occupy the same general position on most specimens. Those on the sixth segment are more constant in number and position. Commonly there are two spiculate setae located dorsally and slightly posterior to the sixth abdominal spiracle although sometimes there may be one or none.

A group of cremastral hooks is found near the anal opening on the tenth abdominal segment. Those measured range in size from 48.5 to 70.5 microns. They are variable in number and position but are prominently clustered in a "C" shaped band around the posterior part of the anal slit.

Although the pigment spots in some individuals are suggestive of a roughened surface, no papillae were noted on the pupae which were not associated with setae.

THE HEAD. *Vertex:* Perhaps the most difficult of the head structures to locate is the vertex, which is reduced to two small triangular sclerites. These lie on either side of the dorsal midline just anterior to the prothorax and just posterior to the bases of the antennae. The vertex lacks both setae and papillae. Its position and its small size preclude its being shown on Fig. 7A or 7B.

Front, Clypeus, Labrum: There is no fronto-clypeal or clypeo-labral suture, which makes the boundaries of these particular areas obscure. Two pores, representing the anterior tentorial pits, are usually apparent between the eyes. Arms of the "U-shaped" suture demarking the limits of the labrum point to the tentorial pits. Since the pits are associated with the lateral margins of the clypeo-labral suture in other insects, we may assume the area between and cephalad of the pits to be the clypeus, which is not distinct from the frons to which the antennae are attached. Below the pits, the labrum is distinct. The region between clypeus and glazed eye-piece is the gena.

The pilifers, caudo-lateral projections of the labrum, are enlarged and in most individuals, meet in the midline caudad of the labrum proper.

Labial Palps: In a few individuals, a small triangular portion of the labial palpi separates the lobes of the pilifers. The external appearance of the labial palps between the pilifers is thus variable in individuals of *comyntas*. The palpi also vary in expression in other species. In *Atlides halesus*, for example, the pilifers touch and the labial palpi can only be seen between the proximal bases of the maxillae.

Maxillae: The maxillae are very prominent just laterad of the mid-line between the pilifers and the central junction of the two antennae. They are only slightly longer than the length of the united distal parts of the antennae (see Fig. 7A).

Eye-pieces: Between the labrum and the entennae are the prominent eye-pieces; a lunate mesal portion has a smooth glassy surface and lacks setae; the lateral sculptured eye-piece has the same texture as the gena.

Antennae: The distal one-third of the antennae are united in the midline. Externally the clavate ends of the antennae appear to stop at the fifth abdominal segment, as do the wings. However, there is a small oblique pocket beneath the fifth segment, into which the tips of the antennae (usually less than 2.0 mm.) fit comfortably. This is best observed in specimens preserved in fluid in which the intersegmental area might be slightly distended due to swelling.

THE THORAX. Thoracic segments are indicated in Figures 7B and 7C. They are similar to other lycaenid pupae in general shape. Proportionate lengths along mid-dorsal line are: prothorax, 2.5; mesothorax, 7.0; metathorax, 1. The mesothoracic spiracle is level with the surface, is not associated with prominences or tubercles and appears plugged with a narrow, highly reticulate cover.

A group of 6 to 8 small pores is found on the distal surface of the mesothoracic leg. Lesser numbers occur in the same position on the prothoracic leg. These openings may vary in number on each side of the body and between individuals, but they are always present. Other species of Lyaenidae also have these pores. They are of unknown function.

THE ABDOMEN. *Honey Gland Scar and Tubercles*: The honey gland scar is located on the dorsum of the seventh abdominal segment in the same position as on the larva. It is more prominent on some specimens when it is pigmented, but it is very difficult to detect in others. Though in other Lycaenidae the pupal honey gland is functional, it is not functional in *E. comyntas*. No markings or scars indicative of the protrusible tubercles could be found on segment eight.

Stridulation: As most lycaenids, *comyntas* pupae are able to stridulate. The noises produced are barely audible and can be best described as slight chirping or squeaking sounds. It is best to place the pupae in a vial or other reflective container in order to hear the sounds.

These organs were first reported in *comyntas* by Downey and Strawn (1963) and Strawn (1964). Downey (1966) subsequently noted the stridulatory organs in pupae of the Palearctic *E. argiades* Pall.

The sound-producing structures are located on the inter-segmental membrane between abdominal segments 5 and 6. To function, a posterior file containing numerous teeth is grated across an anterior stridulating plate. A recurved region of membranous folds lies between the grating surfaces.

Stridulating plate: A narrow (0.05 mm.) band on the dorsal posterior membrane of segment five extending laterally to, or just lateral of, the spiracle. The surface is of grainy texture, with the main axis of the "grains" in a transverse row. Each "grain" has one or more small tubercles whose delineation makes more apparent the reigon of the stridulating plate. The latter is not sclerotized as it is in many other species so that the plate in *comyntas* is defined mostly by its roughened grainy surface. The tubercles range in height from 2 to 5 microns and vary slightly in number and position upon the plate.

Intersegmental fold: This area of the intersegmental membrane is identified by its position and its lack of any sclerotized structure. It is in this region that the membrane folds back on itself so that the anterior plate is in juxtaposition with the posterior file. Two relatively narrow longitudinal muscles are attached by means of short ligaments to the membrane. These attachments are in a dorso-lateral area, midway between the spiracular and the mid-dorsal line. Contraction of the muscles pulls the membrane and produces the grating action of the file against the plate.

File: This area is defined in *comyntas* solely on the presence of teeth. The latter are small, unsclerotized, indistinct protuberances which show a tendency for clustering. The same type of teeth, not quite as numerous, occur in other intersegmental membranes, and also on exposed portions of the pupal integument where they do not contact other surfaces. However, this situation prevails in pupae of over 100 other lycaenid species examined by Downey, and there seems to be little doubt that, in the region of the stridulating plate, the teeth serve as frictional devices in sound production.

The file extends laterally a greater distance than the stridulating plate.

DEHISCENCE. Emergence of the adult is accomplished by a mid-dorsal split of the thoracic segments. As the adult exits through this longitudinal split, it forces the lips apart. This splitting progresses posteriorly along the seam between the wings and the abdomen. Frequently ruptures also occur between the prothorax (to which the vertex usually remains attached) and the antennae, progressing for a variable distance along the antennal suture down the ventral face. The face covering, however, remains attached to the pupal skin. A gradual darkening of the pupae occurs about 48 hours prior to eclosion.

SUMMARY AND CONCLUSIONS

The external morphology of the immature stages of *Everes comyntas* is described and treated in some detail. This includes the egg, head capsules of the various instars, mouth-parts, setal pattern, honey gland, and characters of the pupa.

Different types of setae not previously known for this species are drawn and described.

Variation is found in number and position of the setae on the head and body between individuals of the same instar (except first instar larvae) and between individuals of different instars. Other characters showing variation include depth of the labral notch, segmental ratios of the antennae between instars, setal lengths, morphological structure of the setae, number of crochets, and coloration.

Individual variation is found in the following characters: setal pattern; presence or absence of spiculate setae; presence or absence of the honey gland scar; number size, and position of cremasteral hooks and coloration.

Because of this extreme variation it is suggested that those involved in a comparative description of immature Lepidoptera make a study which is not only thorough in detail but which includes examination of a large number of specimens of all instars.

The honey gland is described on the second, third, and fourth instar larvae, and the scar is noted on the pupa. Eversible tubercles on the third and fourth instar larvae and a pupal stridulating device are described.

A complete setal map of the larva is plotted. Comparison of a first instar setal map of *E. comyntas* with one of *P. icarioides* shows that, though similar in many respects, there are decided differences in presence and absence of seta and lenticles. The usefulness of setal maps of butterfly larvae is demonstrated and should point the way to more work of this type.

Some differences in the prothoracic and anal plates of several lycaenid species are pointed out which suggest that these structures may be of importance in the taxonomy of the larvae of Lycaenidae.

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